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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/065,037	09/12/2002	Timothy J. Havens	GEMS0139PUS	9590

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ARTZ & ARTZ, P.C.
28333 TELEGRAPH RD.
SUITE 250
SOUTHFIELD, MI 48034

EXAMINER	
FETZNER, TIFFANY A	

ART UNIT	PAPER NUMBER
2859	

DATE MAILED: 11/03/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

PTO-90C (Rev. 10/03)

Office Action Summary	Application No.	Applicant(s)
	10/065,037	HAVENS ET AL.
	Examiner	Art Unit
	Tiffany A Fetzner	2859

-- The MAILING DATE of this communication appears on the cov r sh et with the correspondenc address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on 12 September 2002 .

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) 1-20 is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) 1-20 is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on 12 September 2002 is/are: a)☐ accepted or b)☒ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____ .
4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other:

DETAILED ACTION

1. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

Drawings

2. The drawings are objected to as failing to comply with 37 CFR 1.84(p)(5) because they do not include the following reference sign(s) mentioned in the description:

A) In Figure 1 the **super conducting magneti field coils 16**, taught on page 5 paragraph [0022] are not shown.

B) In Figure 1 the **second exterior side 54** and the **cylindrical dielectric former 56**, taught on page 6 paragraph [0026] are not shown. A proposed drawing correction or corrected drawings are required in reply to the Office action to avoid abandonment of the application. The objection to the drawings will not be held in abeyance.

Claim Rejections - 35 USC § 103

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

4. The factual inquiries set forth in *Graham* **v.** *John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

   1. Determining the scope and contents of the prior art.
   2. Ascertaining the differences between the prior art and the claims at issue.
   3. Resolving the level of ordinary skill in the pertinent art.
   4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

5. **Claims 1-17,** and **19** are rejected under **35 U.S.C. 103(a)** as being unpatentable over **Kinanen** US patent **6,433,550 B1** issued August 13h 2002, filed February 13th 2001.

6. With respect to apparatus **claim 1,** and corresponding method **claim 9**, **Kinanen** teaches and suggests "A Magnetic Resonance Imaging (MRI) magnet field instability simulator" (i.e. interpreted as an MRI device, capable or analyzing, and producing corrections for instabilities (i.e. fluctuations, or inhomogeneities) in the magnetic fields produced by the MRI device.) [See Figure 1, force transducer 60, vibration analyzer 62, reconstruction processor 52, local oscillator / synthesizer 80; the abstract; col. 2 line 36 through col. 5 line 60.] **Kinanen** also teaches and suggests components "comprising: a rigid body motion generator" (i.e. force transducer 60 which senses vibrations, disturbances, or rigid body motions of the MRI systems components such as compression or expansion of the magnetic pole pieces in the lateral, vertical, horizontal, or diagonal directions.) [See col. 4 line 21 through col. 5 line 60; abstract; col. 2 lines

36-63]. The examiner notes that the "force transducer 60, vibration analyzer 62, reconstruction processor 52, and local oscillator / synthesizer 80" in combination with one another "simulate", account for (i.e. measure or determine), and compensate for, "motions of one or more MRI system components"; [See Figure 1; the abstract; col. 2 line 36 through col. 5 line 60.]

7. **Kinanen** lacks directly teaching the presence of "an eddy current analyzer" specifically, however, **Kinanen** teaches that RF screens are used to minimize RF eddy currents produced by the gradient coils 24, 26. [See col. 3 lines 60-65] The examiner notes that a shim coil is a type of RF screen, and conventionally shim coils are used to minimize eddy currents, therefore It would have been obvious to one of ordinary skill in the art at the time that the invention was made that shim coils 70 and 72 controlled by shim control 74 for the purpose of counteracting the changes in the magnetic field, is effectively a type of "eddy current analyzer", even though the specific term "eddy current analyzer", is not directly taught by the **Kinanen** reference.

8. The **Kinanen** reference suggests "generating a magnetic stiffness and damping signal" [See col. 4 lines 21-52 where high frequency vibrations are dampened and the hardness and compressibility of the magnetic pole shoes (i.e. the stiffness of the magnet structure itself) is taught to be compensated, by an output voltage. The output voltage is interpreted by the examiner as "an electromagnetic transfer function in response to said motions" (i.e. in response to the sensed vibrational motion of the device). The **Kinanen** reference also suggests "a cryostat material properties signal", because the amount of vibration, the magnetic field strength, the changes in the

resonance frequency, or the shift in sensitivity during the operation of the MRI device are all signals, which are directly related to cyrostatic material properties. Additionally, it would have been obvious to one of ordinary skill in the art at the time that the invention was made that because the **Kinanen** reference does not specify the type or open MR system analyzed, by the vibrational method, (i.e. the **Kinanen** reference lacks a teachings which specifies a permanent, resistive, or superconductive (i.e. cyrostatic) main magnet structure), that all of the conventional permanent, resistive, and / or superconductive (i.e. cyrostatic) MR systems are within the broad scope of the **Kinanen** reference, and that all of the main MR magnets used in conventional MRI devices can be modified to include **Kinanen's** vibrational analyzer, force transducers, and frequency oscillator's / synthesizer's as taught by **Kinanen.** Therefore, the examiner considers the vibrational signals, related to the main magnets, the field strength of the main magnets, the main magnet frequency shifts, and the sensitivity shift of the main magnets to comprise "a cryostat material properties signal".

9. The **Kinanen** reference also teaches and suggests from figure 1, "a mechanical model generator" (i.e. the force transducer, and its generated output waveform are a type of "mechanical model generator" which is capable of "generating a mechanical disturbance signal and a mechanical model of one or more MRI system components in response to said motions and said magnetic stiffness and damping signal;" [See abstract, col. 2 line 6 through col. 3 line 5; col. 4 line 21 through col. 5 line 60]. The **Kinanen** reference also teaches "a structural analyzer" (i.e. vibrational analyzer 62) for "generating a motion signal in response to said mechanical model; and "a field instability

calculator" (i.e. the vibration analyzing processor of col. 2 lines 62-63] for "generating a field instability signal in response to said electromagnetic transfer function and said motion signal". [See col. 4 line 21 through col. 5 line 60; col. 2 lines 36-63].

10. With respect to **claim 2**, **Kinanen** teaches and suggests "at least one of an internal mechanical disturbance signal" (i.e. a fluctuation of the strength of the main field, such as the amount of change, variations in the output voltage waveform, or physical shifts of the radio frequency or gradient coils. [See col. 1 lines 42-62 col. 4 lines 48-52;]) "and an external mechanical disturbance signal" vibrations caused by (i.e. people walking in the examination room, slamming doors, trucks in the street, seismic activity, acoustic reverberations, and RF activity) [See col. 1 line 67 through col. 2 line 5;]. The same reasons for rejection, and obviousness, that apply to **claim 1** also apply to **claim 2**.

11. With respect to **claim 3**, **Kinanen** teaches "said mechanical disturbance signal comprises information corresponding to at least one of cryostat motion, coil motion, magnet motion, and environmental motion." [See abstract, col. 1 line 67 through col. 5 line 60] The same reasons for rejection, and obviousness, that apply to **claims 1, 2** also apply to **claim 3**.

12. With respect to **claim 4**, **Kinanen** teaches "said motion signal comprises information corresponding to at least one of cryostat motion, coil motion, magnet motion, and environmental motion." [See abstract, col. 1 line 67 through col. 5 line 60] The same reasons for rejection, and obviousness, that apply to **claim 1** also apply to **claim 4**.

13. With respect to **claim 5**, **Kinanen** teaches "said mechanical model comprises at least one of magnet geometry material properties, boundary conditions, and magnet stiffness and damping." [See abstract, figure 1, col. 1 line 14 through col. 5 line 60] The same reasons for rejection, and obviousness, that apply to **claim 1**also apply to **claim 5**.

14. With respect to **claim 6**, **Kinanen** suggests that the "structural analyzer" (i.e. vibrational analyzer 62) "converts nodal displacements" (i.e. fluctuations in the distance between the magnetic poles, and magnetic field strength, with an example provided being a displacement of 1 ppm) "into rigid body motions". (i.e. how much the static structures including the magnets, poles, and coils, move. [See col. 1 lines 55-62; col. 2 line 35-63; col. 4 line 21 through col. 5 line 60.] The same reasons for rejection, and obviousness, that apply to **claim 1**also apply to **claim 6**.

15. With respect to **claim 7**, **Kinanen** suggests that the "field instability calculator" (i.e. the vibration analyzing processor of col. 2 lines 62-63] "multiplies" (i.e. scales) "said rigid body motions by said electromagnetic transfer function to produce said field instability signal", because **Kinanen** teaches that the analyzing processor affects the operating frequency of the main oscillator to counteract the vibrations. [See col. 2 lines 40-42; and col. 4 line 61 through col. 5 line 4 where the change in distance is converted into a change in magnetic field Bo, with shim coils counteracting changes in Bo and the waveform inverted and scaled in comparison to the vibration waveform.] The output waveforms are interpreted by the examiner as an "electromagnetic transfer function" and in the **Kinanen** reference the "rigid body motions" (i.e. vibrations) of the actual

system components, is related to the output waveform, and the vibrational waveform, via scaling and inversion to determine and correct the magnetic field instabilities, (i.e. to determine and counteract any fluctuations in the magnetic field. [See col. 4 line 21 through col. 5 line 60; abstract; col. 2 lines 36-63.] The same reasons for rejection, and obviousness, that apply to **claims 1, 6** also apply to **claim 7**.

16. With respect to **claim 8, Kinanen** suggests that the "field instability signal comprises a frequency distribution of field disturbances" [See col. 1 lines 37-62; col. 4 line 21 through col. 5 line 60 where a range 2-70hz; or 5-20hz based on the type of vibrational sensor is taught for the frequency distribution range]. The same reasons for rejection, and obviousness, that apply to **claim 1**also apply to **claim 8**.

17. With respect to **claim 10**, **Kinanen** suggests that the step of "generating an electromagnetic transfer function comprises performing an eddy current analysis" because the RF eddy currents in the gradient coils 24 and 26 are minimized by the RF shimming screens and shim coils 70 and 72; with the shimming controlled by shim coil control 74. [See col. 3 lines 61-65 and col. 4 line 64 through col. 5 line 4] It would have been obvious to one of ordinary skill in the art at the time that the invention was made that in order to minimize the eddy currents, that the location and intensity of the eddy currents produces must necessarily be known, therefore It would have been obvious to one of ordinary skill in the art at the time that the invention was made that the by teaching the minimization of the produced eddy currents, the use of shimming, (i.e. a conventional means of reducing or minimizing eddy currents in the MRI / NMR art) and the teaching of counteracting changes in the magnetic field, which include fluctuations

caused by induced eddy currents, that the **Kinanen** reference does perform an eddy current analysis, even though a direct teaching of a specific "eddy current analysis is lacked by the reference. The same reasons for rejection, and obviousness, that apply to **claims 1, 9** also apply to **claim 10**.

18. With respect to **claim 11**, **Kinanen** teaches and suggests the step of "performing a structural analysis of one or more MRI system components", because a vibrational analysis of the physical structural MRI components, (i.e. the pole pieces, magnets, gradient coils, rf coils, etc. is performed. [See abstract, figure 1, col. 2 line 26 through col. 5 line 60.] . The same reasons for rejection, and obviousness, that apply to **claims 1, 9** also apply to **claim 11**.

19. With respect to **claim 12**, **Kinanen** teaches and suggests the step of converting nodal displacements into rigid body motions'", because **Kinanen** teaches using the displacements of the "rigid body structures", (i.e. the amount of change or movement of the actual magnets, coils, and pole shoes/pieces) to an output waveform of vibration, and a calculated change in Bo that is processed by the vibrational analyzer. [See also the rejection reasons given in the rejection of **claim 7**] The same reasons for rejection, and obviousness, that apply to **claims 1, 6, 7, 9, 11** also apply to **claim 12**.

20. With respect to **claim 13**, **Kinanen** teaches and suggests the step of "multiplying said mechanical disturbance signal by said electromagnetic transfer function", because the activity waveform of the shim coil is inverted and scaled in comparison to the vibration waveform, and the examiner broadly interprets the step of scaling to include the mathematical operations of addition, subtraction, multiplication, and division

intrinsically. [See also the rejection reasons given in the rejection of **claim 7**] The same reasons for rejection, and obviousness, that apply to **claims 1, 6, 7, 9** also apply to **claim 13**.

21. With respect to **claim 14**, **Kinanen** suggests the step of "frequency sweeping said field instability signal to obtain a desired frequency operating range" because **Kinanen** specifically teaches that a 0.5 micrometer variation in aperture varies the Larmour frequency by 10 Hz., and the sensors used for the vibration detection and analysis are taught to provide accurate responses in the 2-70 hz., range, therefore a vibrational instability frequency sweep range of 2-70hz., is taught by the **Kinanen** reference. [See col. 4 line 21 through col. 5 line 60; and col. 1 lines 55-62] The same reasons for rejection, and obviousness, that apply to **claims 1, 9** also apply to **claim 14.**

22. With respect to **claim 15**, **Kinanen** teaches and suggests "modifying at least one MRI system feature to adjust one or more resulting frequency magnitudes" [See col. 4 line 21 through col. 5 line 60] The same reasons for rejection, and obviousness, that apply to **claims 1, 9** also apply to **claim 15**. .

23. With respect to **claim 16**, **Kinanen** teaches and suggests "modifying at least one MRI system feature to adjust a resulting frequency operating band to be approximately within a desired frequency operating range." [See col. 4 line 21 through col. 5 line 60; and col. 1 lines 55-62; where high-pass filters are used to eliminate frequencies below 2hz., in addition to the vibrational instability frequency sweep range of 2-70hz., taught by the **Kinanen** reference; and where the ability to modify the phase, frequency, spatial

location, of the detected frequencies is also taught.] The same reasons for rejection, and obviousness, that apply to **claims 1, 9** also apply to **claim 16**.

24. With respect to **claim 17**, **Kinanen** suggests balancing a resulting eddy current with a resulting amount of MRI system component movement in response to said field instability signal", because in **Kinanen** the activity waveform of the shim coil, is inverted and scaled (i.e. "balanced") in comparison to the vibration waveform, (i.e. "said field instability signal") [See col. 4 line 21 through col. 5 line 60; especially col. 4 line 63 through col. 5 line 4]. The same reasons for rejection, and obviousness, that apply to **claims 1, 9** also apply to **claim 17**.

25. With respect to **claim 19** this claim is just the combination of **method claims 9, 14, and 16** written in independent form therefore the same reasons for rejection, and obviousness, that apply to **claims 1, 9, 14, 16** also apply to **claim 19** and need not be reiterated.

26. **Claims 18, 20** are rejected under **35 U.S.C. 103(a)** as being unpatentable over **Kinanen** US patent **6,433,550 B1** issued August 13h 2002, filed February 13th 2001; in view of **Yamashita** US patent **6,556,012 B2** filed January 19th 2001.

27. With respect to **claim 18**, **Kinanen** lacks directly teaching the step of "modifying a cryostat or cryostat support material in response to said field instability signal". However, **Yamashita** teaches and shows a superconductive MRI cryostat for maintaining the extremely low temperature state of the superconductive coil. [See col. 4 lines 37-45] **Yamashita** also teaches compensating for any vibrations of the system. [See col. 4 line 36 through col. 32 line 45, which explains 15 different embodiments for

compensating for the vibrations produced by the MRI system]. The instability signal of **Yamashita** is also the signal(s) related to the vibrations experienced by the system. **Yamashita** teaches "modifying a cryostat or cryostat support material in response to" the vibrations produced by the system (i.e. "said field instability signal"), [See col. 5 line 2 through col. 6 line 46; col. 22 line 17 through col. 23 line 55; col. 20 lines 5-49]. It would have been obvious to one of ordinary skill in the art at the time that the invention was made to modify the teaching of **Kinanen** with the teaching of **Yamashita,** because the teachings of **Kinanen** apply to any MRI magnet system, while the teachings of **Yamashita,** apply specifically to a superconductive MRI system. The examiner also notes that because the cryostat is a rigid body that is also subject to motion that it also would have been obvious to one of ordinary skill in the art at the time that the invention was made, to modify the teachings of **Kinanen** to also analyze the vibrations generated within a functional superconductive MRI cryostat, because the **Kinanen** reference monitors, analyzes and compensates for all vibrational components in an operational MRI system. The same reasons for rejection, and obviousness, that apply to **claims 1, 9** also apply to **claim 18**.

28. With respect to **claim 20**, **Kinanen** suggests "balancing a resulting eddy current with a resulting amount of MRI system component movement in response to said field instability signal" for the same reasons as those given in the rejection of **claim 17.**

29. **Kinanen** lacks directly teaching the step of using that balance "to determine desired cryostat materials; and modifying a cryostat or cryostat support material to reflect said desired cryostat materials." However, **Yamashita,** specifically determines

and identifies "desired cryostat materials;"), [See col. 5 line 2 through col. 6 line 46; col. 22 line 17 through col. 23 line 55; col. 20 lines 5-49; Figures 1-6; 17-20; 24a-24d; 27-33 and 50-51]. **Yamashita,** also teaches "modifying a cryostat or cryostat support material to reflect said desired cryostat materials." [See col. 5 line 2 through col. 6 line 46; col. 22 line 17 through col. 23 line 55; col. 20 lines 5-49] The same reasons for rejection, and obviousness, that apply to **claims 1, 9, 14, 16, 17, 18, 19** and the motivation to combine that applies to **claim 18,** also apply to **claim 20** and need not be reiterated.

30. The **prior art made of record** and not relied upon is considered pertinent to applicant's disclosure.

A) **Zur** US patent 6,191,582 B1 issued February 12th 2001, filed July 21st 1999 which teaches a method for eddy current compensation, simulation, modeling, and improved stabilization in an NMR / MRI system. See the entire reference.

Conclusion

31. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Tiffany Fetzner whose telephone number is (703) 305-0430. The examiner can normally be reached on Monday-Thursday from 7:00am to 4:30pm., and on alternate Friday's from 7:00am to 3:30pm.

32. If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Diego Gutierrez, can be reached on (703) 308-3875. The fax phone number for the organization where this application or proceeding is assigned is (703) 305-3432.

33. Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 305-0956.

Tiffany A. Fetzner

TAF

October 29, 2003

Diego Gutierrez

Supervisory Patent Examiner

Technology Center 2800

CHRISTOPHER W. FULTON
PRIMARY EXAMINER